

SECTION 5

KEEPING PLANTS

HEALTHY



KEEPING PLANTS HEALTHY

5.1 WATERING CONTAINER PLANTS

These instructions apply to plants in pots that are being grown in a greenhouse or shadehouse. They do not apply to seed flats, with or without seedlings.

What is the single most important technique to learn in order to grow healthy plants?

Proper watering! How much water do we want to give our plants? Just the right amount!

The general idea with watering is to give plants enough water to thrive but not so much that they suffocate, rot, or become susceptible to fungal attack. Plants can suffocate if they are always saturated, as no air is available to the roots. The following guidelines are very general, and some species may need special watering regimes. If you have a question about a specific species, ask your mentor. After studying these directions, water the plants once or twice with someone who has already been trained before doing it on your own. The directions should work whether you are using a hose or an irri-

gation system to apply water to the pots.

Directions

1. Check the plants in the morning to see if they need water. This is the most important part of the process. A plant needs water if the top one-quarter of the soil column is dry.

If you are checking vaders, which are 10 inches tall, the top 2 1/2 inches should be dry before you water.

Why do we let the top of the soil column dry out?

Fungi thrive in constantly moist conditions. If the soil around the crown of the plant stays moist, it allows fungal spores to germinate and attack the plant.

Does this dry soil on top harm the plant? No, after the plant is established the roots draw water from the lower parts of the soil column.

2. Apply the water if needed.

Water in the morning. Our goal is to let the leaves and stem of the plant dry off during the day so that fungi don't form at

night (fungal spores need standing water in which to germinate).

How much water?

Enough to fill the air spaces in the pot. A good potting soil contains about 20 percent air by volume. When we water we are trying to fill up this whole 20 percent with water. Some of the water then drains off, but some of it remains behind, bound to soil particles that hold it until the roots suck it up.

What does this 20 percent mean, practically?

A vader, for example, is 10 inches tall and approximately the same diameter for its entire length. If we know that the soil column is 10 inches tall, then 20 percent (or $1/5$) of this length will be 20 percent of the volume. So we want to apply that much water. In the case of a vader, this would be 2 inches ($10 \times 1/5 = 2$).

How do you measure 2 inches of water?

Using either your hose or the irrigation system, put a straight-sided container marked with inches under the stream of water. Measure the time it takes to fill the container to the 2-inch mark. Apply the

water for that amount of time when you water.

Or the simple way. Basically we want to saturate the soil column. You can be sure you've done this by checking the holes in the bottom of the pot to see if the soil there is wet. When water starts dripping out of the holes, you have watered enough.

When watering with a hose, apply a smaller amount of water twice rather than the whole amount at once. This way you will avoid puddling, which sometimes can seal the top of the soil.

Use a gentle stream of water. If the stream of water is battering the plants, knocking off leaves, or splashing soil out of the pot, find another nozzle or turn down the water pressure.

Be aware of dry spots. They can be caused by a gap in your irrigation system, patterns of shade and sunlight, or plants that use water at different rates. Check as many individual plants as you need to in order to notice the wet and dry areas of your nursery. If the irrigation system seems to be clogged or stuck in certain areas, see if you can clean out the little



Figure 5.1 When to water - finger comes out of pot dry, soil is transparent, and holes at bottom of pot are light colored

filter basket or adjust the system to fix the problem. If you can't, get help from your mentor as soon as possible and hand-water the plants in the meantime.

Some plants are so leafy (especially grasses) that the water cannot reach the soil. These plants may need to be pruned; check with your mentor and hand-water in the meantime to be sure they get a good soaking and don't die. Another strategy for super-leafy plants is to space them out in the racks so that every other hole is empty, giving more space for water to reach each plant in the rack.

3. Let plant dry until top one-quarter of soil is dry again.

Anticipate. If you know it's going to rain in the afternoon, don't water in the morning. If you know the weather is going to be exceptionally hot for a few days, water sooner than you normally would and check the plants more frequently.

5.2 CROP MONITORING

Crop monitoring is what you do each day to check on your plants and to record and deal with any problems you find. (For more information about identifying the causes of problems and treating common plant diseases and pests, see the sections "Diseases" and "Pests" and ask your mentor or the park nursery specialist.) These challenges can threaten the survival of much of our crop of plants, so please act immediately!

Supplies

Clipboard or notebook with Crop Monitoring Record Form
Hand lens

Pruning shears
Ziplock bags

Procedure

■ Observe the weather. Record the temperature both outside and in the greenhouse, using the minimum-maximum thermometer in the greenhouse to get high and low temps.

■ Walk through the greenhouse and shade structures and really look at the plants. Go up every aisle, look at both sides of each bench and pallet.

■ If plants need thinning, pruning, fertilizing, or transplanting, record this on the Crop Monitoring Form. Be sure to take care of necessary tasks or remind your mentor to help you do needed work as soon as possible.

■ Using a hand lens, examine any plants that look odd. Look for bugs and disease. Note any evidence of bugs: honeydew, eggs, curled or distorted leaves, holes in leaves. Make notes of what you find and record numbers of insects or mites (even if it's just "a few," "some," or "lots") and exactly where they are found.

■ Note how much of the crop (species) is affected by disease.

■ Are natural enemies present? Are they gaining control? Note this and call your mentor if it seems like the plants are dying.

■ Take samples. Shake bugs into ziplock bags. If the plant is diseased, prune it just below where infection can be seen and put pruned section in a ziplock bag.

■ Identify or give to nursery specialist, and take responsibility for treating the problem.

■ Make a note of action to prevent spread. If you don't know what to do, call the nursery specialist. That's why we have one!

■ Remember: Take action the day you discover a problem.

5.3 IN THE SHADE HOUSE

Once the young plants go into the shade house, what do we need to do to keep them healthy? How do we organize the plants in the shade house?

Pots must be kept up off the ground so **air pruning** of the roots can take place. A root will not grow out into free air. If the tubes are on the ground, the roots may grow right into the soil. Plants can be severely shocked or killed if these roots are torn off when the pot is picked up.

There can be a problem with air circulation and light reaching the middle of a rack. Plants in racks are very close together. Space permitting, the racks should be spread out and sun-loving species put into the sun as soon as possible. If possible, plants can be spaced out so there is a tube in every other hole, with alternate holes left empty to let air, sun, and overhead water into each pot.

The top of the plant will sometimes stretch to get more sun if the tubes are too close together. Sunlight cannot reach the bottom of the plant if it has many leaves on the top. The cells on the main stem of the plant will elongate ("reach for the sun") and this can weaken the plant, making it limp or floppy. When we space the tubes out so sunlight can get to all the leaves, we also prevent fungal problems. Air circulation around the plants dries moisture that would encourage the germination of fungal spores.

Remove any weeds and any dead, diseased, or unhealthy native plants from the nursery. Weed seed, fungus, bacteria, and virus can spread to healthy plants. Carry a 5-gallon bucket with you to hold the plants and tubes you are dumping. A small plant isn't necessarily unhealthy or diseased, it's

just small; don't dump it! We retain small, healthy plants to diversify the gene pool of the plants we are growing. All types of plants are to be planted, large or small. The small plant may be more disease- or drought-resistant and may be the one to survive if drought or disease occurs.

Good pest and disease control must always be carried out. By keeping pots, tables, greenhouses, and shade houses clean, we prevent most problems with native plants. If plants are stressed—root-bound or not getting necessary nutrients—cell walls thin and crack and sugars may leak out and attract fungus or insects.

Natural enemies and competitors are usually present, helping control the pests so they don't take over the nursery. We grow relatively small numbers of plants of each species, so pests do not thrive to the extent that they do in commercial nurseries. **Monocultures**, or huge crops of a single species, create a haven for pests because if they are well adapted to thrive on the single species being grown, they can multiply exponentially (and very quickly).

To keep our plants healthy and able to resist invaders, we fertilize them periodically. Keep an eye on the tags for each rack and flat of pots to see when fertilizer should be added. Three months after seed is sown, add 1 teaspoon of Nutricote to each pot. When you do this, note it on the tags and in the records.

If you succeed in keeping your plants healthy, they will be in perfect condition to plant after the rains begin in December. Your plantings will establish, survive, and become a haven for native birds, mammals, and insects. The plants will reproduce not just for one year but for our lifetimes, our grandchildren's lifetimes, and beyond.

5.4 PRUNING

In herbaceous non-woody plants, we pinch or **prune** back the top of the plant. In plants, growth begins from the buds. The buds contain tissue (**meristem**) that has not yet **differentiated** into stems, leaves, or roots. Usually the **terminal bud**, the one at the top of the plant, will grow first, especially if that is the area receiving the most sunlight. At the base of each leaf there is an **axillary**, or **lateral**, bud, also containing meristematic tissue. By removing the terminal bud, the lateral or axillary buds are induced to grow. If the terminal bud is pinched or pruned, usually one or two lateral buds will sprout just below. If the plant is pruned further down the stem, lower buds will begin growing and branching will take place from the base of the plant.

As a general rule, when pruning, we leave the bottom three buds or sets of leaves on the plant and remove everything above that. This will result in strong bushy plants. The cut should be

made just above the third bud or set of leaves from the bottom.

If a long stem is left above a bud, it will die back, since there are no leaves to feed its growth. If we prune just above a bud, the bud will break and grow a branch with leaves that send food (**photosynthates**) back down the stem.

We don't prune the trees we grow, as we want to retain the single main stem or trunk.

How do I know when to prune?

As you do your daily crop monitoring, clip off any seedheads or flowers on your plants. Be sure to clean the shears with rubbing alcohol in between plants to prevent the spread of disease.

During the summer, until the end of August, plants should be pruned heavily. Generally, when we outplant, we want the tops of the plants to be no taller than the height of the pot. (A luke is 8 inches deep, so the plant's leafy top should be no more than 8 inches high.) Until the end of



Figure 5.2 Node with leaf and bud. Leave three nodes on plant when pruning

August, plants can be cut back by half, or to three nodes. They will regrow before going dormant. After September 1, only light pinching (no more than 1 to 2 inches removed) should be done. This prevents the plants from making a lot of soft new growth that would be damaged when the cold weather arrives.

As a general rule, a plant should not get much taller than the depth of its pot. For species that spread laterally, each plant should be contained for the most part to its own pot and should not be so dense that water cannot penetrate the foliage to reach the soil. Lots of foliage means the plant is using more water and nutrients, which can stress the plant and lead to disease. In the nursery, native plants should have big strong roots and a moderate amount of greenery on top; this gives them a better chance of surviving outplanting.

Pruning Guidelines for Species Commonly Grown at the Oceana Nursery

ACMI (yarrow)

This species is hardy. You can cut yarrow back to about 2 to 3 inches. Leave some but not the entire leaf. Just clip like grasses; it should go really fast since there are no nodes to worry about.

PHCA (phacelia)

Leave a rosette at the base of the plant. Clip off any leaves or flowers above that. If the plants are huge, you can cut them back to just a few leaves at the base and they should recover.

ERLA (buckwheat)

Cut them to about two nodes.

FERU (red fescue)

Grasses are easy. Make sure you keep the seed heads clipped back. Use the shears and like a lawnmower, down to about 2 to 3 inches.

BRCA (California brome)

Same as red fescue.

5.5 PLANT NUTRITION

Just as we provide children with good nutrition, basic nutrition must be given to plants. You can't raise a healthy child—or plant—on water and air. When plants are grown in tubes, some nutrients will be missing from the potting soil medium. To provide better nutrition to the growing plants, we add a balanced fertilizer (Nutricote) to our potting soil, and then **top dress**, or sprinkle 1 teaspoon per pot on top of the soil every three months. After September, only 1/8 teaspoon should be added; this keeps the plant healthy without encouraging new growth. With most of our species, slow-release fertilizer is all that is needed.

Nutrient Cycle

Plants take in basic elements and convert them to the sugars and carbohydrates on which we depend for nutrition. Plants are the foundation (or **primary producers**) of all food chains because they produce food that includes all the basic vitamins and nutrients that animals (including humans) need to survive. With sixteen elements plus sunlight, plants can manufacture everything they need to stay healthy. By far the most necessary elements for the plant are oxygen and carbon; hydrogen ranks third. These elements are easily attained from the atmosphere as carbon dioxide (CO₂) and water (H₂O). Plants also need many other elements to grow, and are inhibited by the lack of one or more of these elements.

Nitrogen, potassium, calcium, magnesium, phosphorus, and sulfur are the main elements in a plant. However, minute quantities of chlorine, iron, boron,

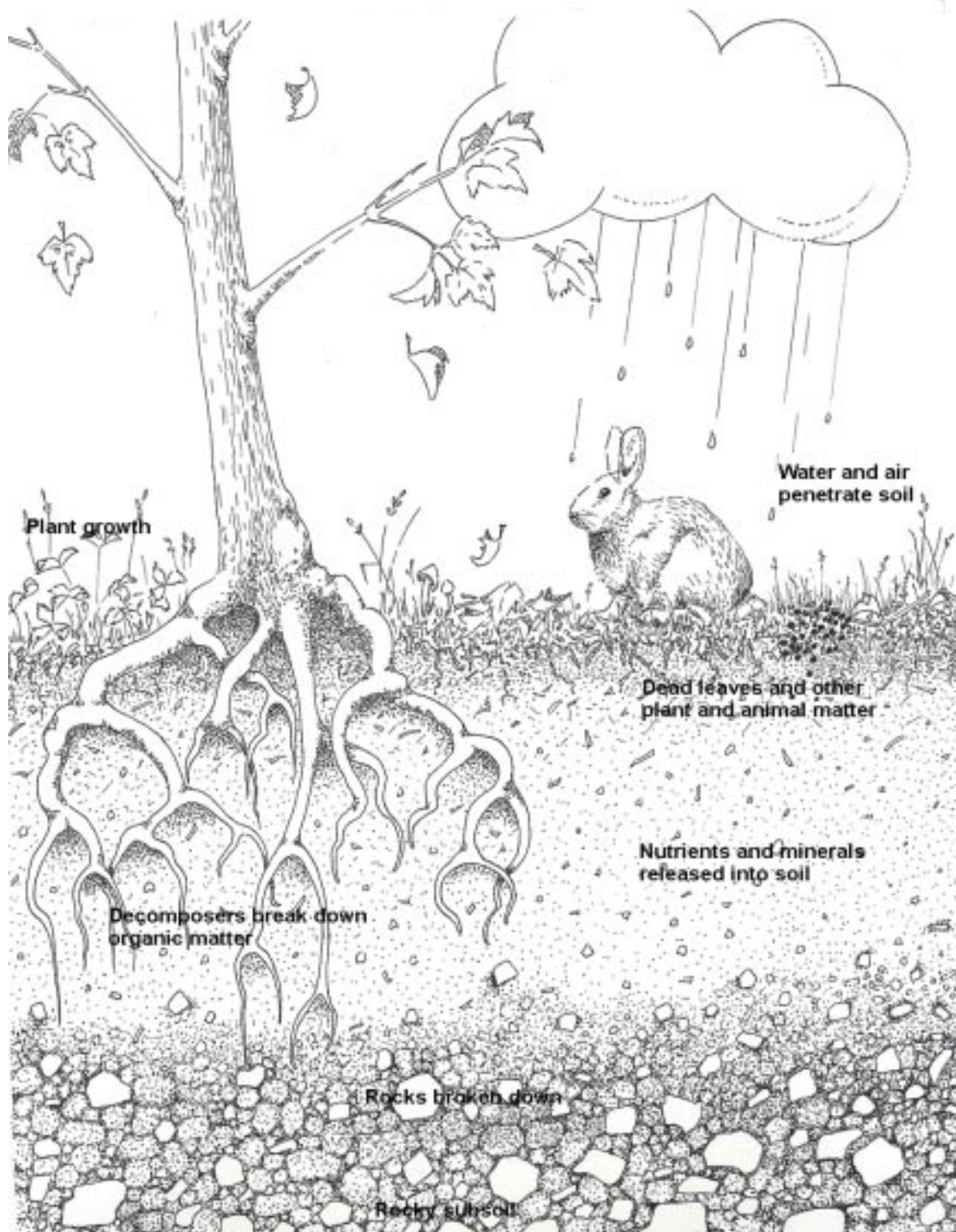


Figure 5.3 The Nutrient Cycle



Figure 5.4 Web of life

manganese, zinc, copper, and molybdenum are also needed. The relative amounts of each element needed vary greatly. For example, a typical corn plant contains 450,000 times more carbon or oxygen than molybdenum.

Nitrogen (N) is taken up by the plant as NO_3^- , NH_4^+ . Our soils are commonly deficient in nitrogen because it is water soluble and washes away with irrigation and rain water runoff. It readily moves around inside the plant. **Plants without sufficient nitrogen grow slowly** and tend to be pale green to yellow, while stems may be red to purple. Too much nitrogen and they will have many large, lush, very dark green leaves. We do not want this in our plants, as they will survive better if the top of the plant is smaller than the root mass (high root-to-shoot ratio). We must provide enough nitrogen to have healthy plants, but not so much that growth gets out of hand.

Phosphorus (P) stimulates good root growth. It also speeds maturity, flowering and seed formation. Plants lacking phosphorus are stunted and can be dark green (as opposed to nitrogen-deficient plants that are light green). Also, **phosphorus-deficient plants often show red or purple (anthocyanin pigment)** in the older leaves, as the plant takes P from the old leaves to be used by the new leaves, flowers, and seed.

Potassium (K) is the other element usually lacking in our soils. It helps develop strong cell walls, which maintain the plant's resistance to the entry of fungal spores, bacteria, or virus. It also moves from the older to younger leaves in the plant, and **deficiency symptoms show up first in the older leaves, which become pale green or yellowish and often have scattered dead spots on them.**

The other elements are usually in suffi-

cient supply in the soil, depending on the pH (**relative acidity**). For more details on specific nutrients, see the "Plant Nutrition" section (page 66).

We use a **controlled-release fertilizer** (Nutricote or Osmocote) to provide N, P, and K, and minute quantities of other essential elements. These products are resin-coated pellets that release nutrients in tiny amounts when wet; they usually last about ninety days (the fertilizer bag will indicate the length of time the nutrients are available to the plant). The content of the pellets will also be shown on the bag (e.g., 14-14-14). These numbers represent the percent of nitrogen, phosphorous, and potassium. If a bag weighs 100 pounds, it has 14 pounds of nitrogen, 14 of phosphorus, and 14 of potassium. The bag also lists the micronutrients in the pellets. Generally, we use a formulation in which the percentage of nitrogen is equal to or less than the percentage of phosphorous. This low ratio of nitrogen will encourage good root development with a leaf area that is in proportion to the roots.

Since it is made up of decaying plant parts, **compost** contains the necessary elements for good plant growth. Sometimes compost can be low in nitrogen, which is often lost as a gas, N_2 , during decomposition. Other elements may be in short supply if the compost is not fully broken down to useable elements. Sometimes, fertilizers like Nutricote or bone- or blood meal need to be added if the compost does not provide all essential elements. Your compost mix can be tested at a special lab to determine if it has everything needed.

Compost could be used in our media if it could be held at 150° F for several weeks. If the compost pile does not heat to 150°F, the compost can harbor disease organisms. Consistent high temperatures are also necessary to kill weed seed. If you

would like to use compost in potting mixes, check with your mentor or the nursery specialist to determine how you can maintain your compost pile at these high temperatures.

5.6 RECORD KEEPING

Why is it important to keep records?

Though there are volumes of instructions on the topic of growing and maintaining popular landscape plants, very little information is available on how to propagate indigenous plants. In the native plant nurseries, we are trying to build a solid base of information about the best techniques for propagating, growing, and outplanting in the park, figuring out what works and what doesn't. We have a very long way to go before we know all—or even most—of the answers.

You can help with this very important effort by recording all the information about the plants you work with in the nursery. Seed-sowing dates and germination dates from the previous year tell us how long to wait for the seeds to germinate this year. Knowing how many seeds we sow, how many germinate, and how many die after being transplanted tells us exactly how many seeds we need to collect for the following year. This is important, as we have to be sure we've collected enough to grow the plants we need without over-collecting, which decreases the plants' ability to reproduce naturally.

To gather this information, the nursery has forms, Propagation and Transplant Records, and Species Information Sheets. The nursery staff will show you how to fill them out. Only by keeping these records can we learn what we did wrong (so that

we can correct it in the future), or what we did right (so we can repeat it).

At the end of the calendar year (November or December), look at each crop and make final notes on the Species Information Sheets.

- Were the plants too big? If so, we may need to sow them later in the year or use less fertilizer.

- Were the plants too small? If so, we should sow them earlier, use more fertilizer, or they may need better drainage (more perlite in the potting mix).

- Insects? What were they? What condition were the plants in when they were attacked?

- Were roots rotted and brown? The plants may need better drainage (more perlite).

The importance of keeping records cannot be overestimated.